



WORKSHEET

Probability Distribution Table Question

Question Description: This style of question asks you to “draw up a probability distribution table”. Below are many times they have asked this style with the included exam paper they are extracted from. As you can also see they will ask you to find the expectation and variance using your probability distribution table.

From Formula Sheet:

Discrete random variables

$$E(X) = \sum xp,$$

$$\text{Var}(X) = \sum x^2 p - \{E(X)\}^2$$

QUESTIONS

Q1 s2016_p62

A particular type of bird lays 1, 2, 3 or 4 eggs in a nest each year. The probability of x eggs is equal to kx , where k is a constant.

- (i) Draw up a probability distribution table, in terms of k , for the number of eggs laid in a year and find the value of k . [3]
- (ii) Find the mean and variance of the number of eggs laid in a year by this type of bird. [3]

Q2 s2016_p63

Two ordinary fair dice are thrown. The resulting score is found as follows.

- If the two dice show different numbers, the score is the smaller of the two numbers.
- If the two dice show equal numbers, the score is 0.

- (i) Draw up the probability distribution table for the score. [4]
- (ii) Calculate the expected score. [2]

Q3 w2017_p63

A fair die with faces numbered 1, 2, 2, 2, 3, 6 is thrown. The score, X , is found by squaring the number on the face the die shows and then subtracting 4.

- (i) Draw up a table to show the probability distribution of X . [3]
- (ii) Find $E(X)$ and $\text{Var}(X)$. [3]

Q4 s2018_p62

Mrs Rupal chooses 3 animals at random from 5 dogs and 2 cats. The random variable X is the number of cats chosen.

- (i) Draw up the probability distribution table for X . [4]
- (ii) You are given that $E(X) = \frac{6}{7}$. Find the value of $\text{Var}(X)$. [2]

Q5 s2018_p63

A game is played with 3 coins, A , B and C . Coins A and B are biased so that the probability of obtaining a head is 0.4 for coin A and 0.75 for coin B . Coin C is not biased. The 3 coins are thrown once.

- (i) Draw up the probability distribution table for the number of heads obtained. [5]
- (ii) Hence calculate the mean and variance of the number of heads obtained. [3]

Q6 w2018_p62

A fair red spinner has 4 sides, numbered 1, 2, 3, 4. A fair blue spinner has 3 sides, numbered 1, 2, 3. When a spinner is spun, the score is the number on the side on which it lands. The spinners are spun at the same time. The random variable X denotes the score on the red spinner minus the score on the blue spinner.

- (i) Draw up the probability distribution table for X . [3]
- (ii) Find $\text{Var}(X)$. [3]
- (iii) Find the probability that X is equal to 1, given that X is non-zero. [3]

Q7 w2018_p63

A fair 6-sided die has the numbers $-1, -1, 0, 0, 1, 2$ on its faces. A fair 3-sided spinner has edges numbered $-1, 0, 1$. The die is thrown and the spinner is spun. The number on the uppermost face of the die and the number on the edge on which the spinner comes to rest are noted. The sum of these two numbers is denoted by X .

- (i) Draw up a table showing the probability distribution of X . [3]
- (ii) Find $\text{Var}(X)$. [3]

Q8 s2019_p63

A fair five-sided spinner has sides numbered $1, 1, 1, 2, 3$. A fair three-sided spinner has sides numbered $1, 2, 3$. Both spinners are spun once and the score is the product of the numbers on the sides the spinners land on.

- (i) Draw up the probability distribution table for the score. [4]
- (ii) Find the mean and the variance of the score. [3]
- (iii) Find the probability that the score is greater than the mean score. [2]

Q9 w2019_p62

A fair red spinner has four sides, numbered $1, 2, 3, 3$. A fair blue spinner has three sides, numbered $-1, 0, 2$. When a spinner is spun, the score is the number on the side on which it lands. The spinners are spun at the same time. The random variable X denotes the score on the red spinner minus the score on the blue spinner.

- (i) Draw up the probability distribution table for X . [4]
- (ii) Find $\text{Var}(X)$. [3]

Q10 s2018_p61

Andy has 4 red socks and 8 black socks in his drawer. He takes 2 socks at random from his drawer.

- (i) Find the probability that the socks taken are of different colours. [2]

The random variable X is the number of red socks taken.

- (ii) Draw up the probability distribution table for X . [3]
- (iii) Find $E(X)$. [1]

Q11 w2017_p62

A box contains 6 identical-sized discs, of which 4 are blue and 2 are red. Discs are taken at random from the box in turn and not replaced. Let X be the number of discs taken, up to and including the first blue one.

(i) Show that $P(X = 3) = \frac{1}{15}$. [2]

(ii) Draw up the probability distribution table for X . [3]

Q12 s2017_p62

In a probability distribution the random variable X takes the value x with probability kx^2 , where k is a constant and x takes values $-2, -1, 2, 4$ only.

(i) Show that $P(X = -2)$ has the same value as $P(X = 2)$. [1]

(ii) Draw up the probability distribution table for X , in terms of k , and find the value of k . [3]

(iii) Find $E(X)$. [2]

Q13 w2016_p62

Noor has 3 T-shirts, 4 blouses and 5 jumpers. She chooses 3 items at random. The random variable X is the number of T-shirts chosen.

(i) Show that the probability that Noor chooses exactly one T-shirt is $\frac{27}{55}$. [3]

(ii) Draw up the probability distribution table for X . [4]

Q14 w2018_p61

A random variable X has the probability distribution shown in the following table, where p is a constant.

x	-1	0	1	2	4
$P(X = x)$	p	p	$2p$	$2p$	0.1

(i) Find the value of p . [1]

(ii) Given that $E(X) = 1.15$, find $\text{Var}(X)$. [2]

Q15 w2019_p61

In a probability distribution the random variable X takes the values $-1, 0, 1, 2, 4$. The probability distribution table for X is as follows.

x	-1	0	1	2	4
$P(X = x)$	$\frac{1}{4}$	p	p	$\frac{3}{8}$	$4p$

- (i) Find the value of p . [2]
- (ii) Find $E(X)$ and $\text{Var}(X)$. [3]
- (iii) Given that X is greater than zero, find the probability that X is equal to 2. [2]

Q16 w2017_p61

The discrete random variable X has the following probability distribution.

x	1	2	3	6
$P(X = x)$	0.15	p	0.4	q

Given that $E(X) = 3.05$, find the values of p and q . [4]

ANSWERS

Q1

(i)	<table><tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>$P(x)$</td><td>k</td><td>$2k$</td><td>$3k$</td><td>$4k$</td></tr></table>	x	1	2	3	4	$P(x)$	k	$2k$	$3k$	$4k$	B1	Probability Distribution Table, either k or correct numerical values
	x	1	2	3	4								
	$P(x)$	k	$2k$	$3k$	$4k$								
$10k = 1$	M1	Summing probs involving k to = 1, 3 or 4 terms											
	$k = 1/10$	A1 [3]											
(ii)	$E(X) = 1/10 + 4/10 + 9/10 + 16/10 = 3$	B1	Correct mean										
	$Var(X) = 1/10 + 8/10 + 27/10 + 64/10 - 3^2$	M1	Correct method seen for var, their k and μ										
	$= 1$	A1 [3]											

Q2

(i)	$P(0) = 6/36, P(1) = 10/36, P(2) = 8/36$ $P(3) = 6/36, P(4) = 4/36, P(5) = 2/36$	B1 B1 M1 A1 [4]	Table oe seen with 0, 1, 2, 3, 4, 5 (6 if $P(6) = 0$) Any three probs correct $\Sigma p = 1$ and at least 3 outcomes All probs correct
(ii)	mean score = $(0 \times 6 + 1 \times 10 + 16 + 18 + 16 + 10)/36$ $= 70/36$ (35/18, 1.94)	M1 A1 [2]	Using Σxp (unsimplified) on its own – condone Σp not = 1

Q3

(i)	<table><tr><td>x</td><td>-3</td><td>0</td><td>5</td><td>32</td></tr><tr><td>Prob</td><td>1/6</td><td>1/2</td><td>1/6</td><td>1/6</td></tr></table>	x	-3	0	5	32	Prob	1/6	1/2	1/6	1/6	B1	At least 3 different correct values of X (can be unsimplified)
	x	-3	0	5	32								
	Prob	1/6	1/2	1/6	1/6								
		B1	Four correct probabilities in a Probability Distribution table										
	B1	Correct probs with correct values of X											
		3											

(ii)	$E(X) = -3/6 + 5/6 + 32/6 = 34/6 = 17/3$ (5.67)	M1	Subst their attempts at scores in correct formula as long as 'probs' sum to 1
	$\text{Var}(X) = 9/6 + 25/6 + 1024/6 - (34/6)^2$	M1	Subst their attempts at scores in correct var formula
	$= 144 \left(\frac{1298}{9} \right)$	A1	Both answers correct
		3	

Q4

(i)	<table><tr><td>X</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Prob</td><td>$\frac{2}{7}$</td><td>$\frac{4}{7}$</td><td>$\frac{1}{7}$</td></tr></table>	X	0	1	2	Prob	$\frac{2}{7}$	$\frac{4}{7}$	$\frac{1}{7}$	B1	Prob distribution table drawn, top row correct with at least one probability $0 < p < 1$ entered, condone additional values with $p = 0$ stated
	X	0	1	2							
	Prob	$\frac{2}{7}$	$\frac{4}{7}$	$\frac{1}{7}$							
	$P(0) = \frac{5}{7} \times \frac{4}{6} \times \frac{3}{5} = \frac{2}{7}$ (0.2857)	B1	One probability correct (need not be in table)								
	$P(1) = \frac{2}{7} \times \frac{5}{6} \times \frac{4}{5} \times {}^3C_1 = \frac{4}{7}$ (0.5713)	B1	Another probability correct (need not be in table).								
$P(2) = \frac{2}{7} \times \frac{1}{6} \times \frac{5}{5} \times {}^3C_2 = \frac{1}{7}$ (0.1429)	B1	Values in table, all probs correct (to 3SF) or 3 probabilities summing to 1									
		4									
(ii)	$\text{Var}(X) = 1 \times \frac{4}{7} + 4 \times \frac{1}{7} - \left(\frac{6}{7}\right)^2$ $= \frac{8}{7} - \left(\frac{6}{7}\right)^2$	M1	Unsimplified correct numerical expression for variance or their probabilities from (i) $0 < p < 1$ in unsimplified variance expression								
	$= \frac{20}{49}$ or 0.408	A1	Correct answer (0.40816...) nfww Final answer does not imply the method mark								
			2								

Q5

(i)	$P(0) = 0.6 \times 0.25 \times 0.5 = 0.075$ $P(1) = 0.4 \times 0.25 \times 0.5 + 0.6 \times 0.75 \times 0.5 + 0.6 \times 0.25 \times 0.5 = 0.35$ $P(2) = 0.4 \times 0.75 \times 0.5 + 0.4 \times 0.25 \times 0.5 + 0.6 \times 0.75 \times 0.5 = 0.425$ $P(3) = 0.4 \times 0.75 \times 0.5 = 0.15$	B1	0, 1, 2, 3 seen as top line of a pdf table OR attempting to evaluate P(0), P(1), P(2) and P(3)
		M1	Multiply 3 probabilities together from 0.4 or 0.6, 0.25 or 0.75, 0.5 with or without a table
		M1	Summing 3 probabilities for P(1) or P(2) with or without a table
		B1	One correct probability seen.
		A1	All correct in a table
		Total:	5
(ii)	$E(X) = 0.35 + 2 \times 0.425 + 3 \times 0.15 = 1.65 \left(\frac{33}{20} \text{ oe} \right)$	M1	Correct unsimplified expression for the mean using their table, $\sum p = 1$; can be implied by correct answer
(ii)	$\text{Var}(X) = 0.35 + 4 \times 0.425 + 9 \times 0.15 - 1.65^2$	M1	Correct unsimplified expression for the variance using their table and their mean ² subtracted, $\sum p = 1$
	$= 0.678 \text{ (0.6775)} \left(\frac{271}{400} \text{ oe} \right)$	A1	Correct answer
	Total:	3	

Q6

(i)	<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>p</td><td>$\frac{1}{12}$</td><td>$\frac{2}{12}$</td><td>$\frac{3}{12}$</td><td>$\frac{3}{12}$</td><td>$\frac{2}{12}$</td><td>$\frac{1}{12}$</td></tr></table>	x	-2	-1	0	1	2	3	p	$\frac{1}{12}$	$\frac{2}{12}$	$\frac{3}{12}$	$\frac{3}{12}$	$\frac{2}{12}$	$\frac{1}{12}$	B1	-2, -1, 0, 1, 2, 3 seen as top line of a pdf table with at least 1 probability OR attempting to evaluate P(-2), P(-1), P(0), P(1), P(2), P(3) (condone additional values with $p=0$ stated)
	x	-2	-1	0	1	2	3										
	p	$\frac{1}{12}$	$\frac{2}{12}$	$\frac{3}{12}$	$\frac{3}{12}$	$\frac{2}{12}$	$\frac{1}{12}$										
		B1	At least 4 probs correct (need not be in table)														
	B1	All probs correct in a table															
	3																
(ii)	$E(X) = \frac{-2 \times 1 - 1 \times 2 + 0 + 1 \times 3 + 2 \times 2 + 1 \times 3}{12} = 0.5$	M1	Unsimplified expression for mean using <i>their</i> pdf table (or correct) with at least 2 non-zero values (may be seen in variance). Numerator terms may be implied by values.														
	$Var(X) = \frac{(-2)^2 \times 1 + (-1)^2 \times 2 + 1^2 \times 3 + 2^2 \times 2 + 3^2 \times 1}{12} - (their\ 0.5)^2$	M1	Unsimplified expression for variance using <i>their</i> pdf table (or correct) with at least 2 non-zero values and <i>their</i> E(X). Numerator terms may be implied by values. If $-k^2$ is seen for $(-k)^2$, the method must be confirmed by seeing value used correctly														
	$26/12 - 1/4 = 23/12$	A1	Correct final answer														
		3															
(iii)	Method 1																
	$P(X \text{ non-zero}) = 9/12$	B1ft	If Binomial distribution used 0/3 $P(X \text{ non-zero})$ ft from <i>their</i> pdf table, $\Sigma p=1$ oe														
	$P(X = 1 X \text{ non-zero}) = \frac{P(X = 1 \cap X \text{ non-zero})}{P(X \text{ non-zero})} = \frac{3/12}{9/12}$	M1	<i>Their</i> $P(X = 1)$ / <i>their</i> $P(X \text{ non-zero})$ from <i>their</i> pdf table oe														
	$= 1/3$ oe	A1	Correct final answer www														
	Method 2																
	$P(X = 1 X \text{ non-zero}) = \frac{\text{Number of outcomes} = 1}{\text{Number of non-zero outcomes}}$	B1ft	Number of non-zero outcomes (expect 9) ft from <i>their</i> outcome table or pdf table numerators oe														
		M1	a/b , $a = \text{their } 3$ from <i>their</i> outcome table or pdf table numerators, $b = \text{their } 9$ (not 12)														
	$= \frac{3}{9} = \frac{1}{3}$ oe	A1	Correct final answer www														
	3																

Q7

(i)	<table><tr><td>x</td><td>-2</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>$P(X = x)$</td><td>$\frac{2}{18}$</td><td>$\frac{4}{18}$</td><td>$\frac{5}{18}$</td><td>$\frac{4}{18}$</td><td>$\frac{2}{18}$</td><td>$\frac{1}{18}$</td></tr></table>	x	-2	-1	0	1	2	3	$P(X = x)$	$\frac{2}{18}$	$\frac{4}{18}$	$\frac{5}{18}$	$\frac{4}{18}$	$\frac{2}{18}$	$\frac{1}{18}$	B1	-2, -1, 0, 1, 2, 3 seen as top line of a pdf table OR attempting to evaluate $P(-2)$, $P(-1)$, $P(0)$, $P(1)$, $P(2)$, $P(3)$,
	x	-2	-1	0	1	2	3										
	$P(X = x)$	$\frac{2}{18}$	$\frac{4}{18}$	$\frac{5}{18}$	$\frac{4}{18}$	$\frac{2}{18}$	$\frac{1}{18}$										
		B1	At least 4 probs correct (need not be in table)														
	B1	All probs correct in a table															
	3																
(ii)	$E(X) = \frac{-4 - 4 + 0 + 4 + 4 + 3}{18} = \frac{1}{6}$	M1	Correct unsimplified expression for the mean using their table, $\Sigma p = 1$, may be implied														
	$\text{Var}(X) = \frac{8 + 4 + 0 + 4 + 8 + 9}{18} - \left(\frac{1}{6}\right)^2$ $= 11/6 - 1/36 \text{ (1.8333 - 0.02778)}$	M1	Correct, unsimplified expression for the variance using their table, and their mean ² subtracted. Allow $\Sigma p \neq 1$														
	$= 65/36, (1.81)$	A1	Correct answer														
		3															

Q8

(i)	<table><tr><td>score</td><td>1</td><td>2</td><td>3</td><td>4</td><td>6</td><td>9</td></tr><tr><td>prob</td><td>$\frac{3}{15}$</td><td>$\frac{4}{15}$</td><td>$\frac{4}{15}$</td><td>$\frac{1}{15}$</td><td>$\frac{2}{15}$</td><td>$\frac{1}{15}$</td></tr></table>	score	1	2	3	4	6	9	prob	$\frac{3}{15}$	$\frac{4}{15}$	$\frac{4}{15}$	$\frac{1}{15}$	$\frac{2}{15}$	$\frac{1}{15}$	B1	Probability distribution table with correct scores, allow extra score values if probability of zero stated
	score	1	2	3	4	6	9										
	prob	$\frac{3}{15}$	$\frac{4}{15}$	$\frac{4}{15}$	$\frac{1}{15}$	$\frac{2}{15}$	$\frac{1}{15}$										
		B1	2 probabilities (with correct score) correct														
		B1	3 or more correct probabilities with correct scores														
	B1	FT $\Sigma p = 1$, at least 4 probabilities															
		4															
(ii)	$\text{mean} = \frac{(3+8+12+4+12+9)}{15} = \frac{48}{15} \text{ (3.2)}$	B1															
	$\text{Var} = \frac{(3+16+36+16+72+81)}{15} - (\text{their } 3.2)^2$	M1	FT Substitute <i>their</i> attempts at scores in correct var formula, must have “– mean ² ” (condone probabilities not summing to 1)														
	$= \frac{224}{15} - 3.2^2 = 4.69 \left(\frac{352}{75} \right)$	A1															
		3															
(iii)	Score of 4, 6, 9	M1	Identifying relevant scores from <i>their</i> mean and <i>their</i> table														
	Prob $\frac{4}{15}$ (0.267)	A1	Correct answer SC B1 for 4/15 with no working														
		2															

Q9

(i)	<table><tr><td>x</td><td>-1</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>p</td><td>$\frac{1}{12}$</td><td>$\frac{1}{12}$</td><td>$\frac{3}{12}$</td><td>$\frac{2}{12}$</td><td>$\frac{3}{12}$</td><td>$\frac{2}{12}$</td></tr></table>	x	-1	0	1	2	3	4	p	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{3}{12}$	$\frac{2}{12}$	$\frac{3}{12}$	$\frac{2}{12}$	B1	Table with correct values of x , at least 1 probability, all probabilities ≤ 1
	x	-1	0	1	2	3	4										
	p	$\frac{1}{12}$	$\frac{1}{12}$	$\frac{3}{12}$	$\frac{2}{12}$	$\frac{3}{12}$	$\frac{2}{12}$										
		B1	2 probabilities correct, may not be in table														
		B1	2 more probabilities correct, may not be in table														
	B1	All correct, values in table SC1 No more than 1 correct probability and at least 5 probabilities summing to 1 in table															
	4																
(ii)	$[E(X)] = \left(\frac{-1+0+3+4+9+8}{12} \right) = \frac{23}{12}$	M1	May be implied by use in variance. Allow unsimplified expression														
	$[\text{Var}(X)] = \frac{1+0+3+8+27+32(=71)}{12} - \left(\frac{23}{12} \right)^2$	M1	Appropriate variance formula using <i>their</i> $E(X)^2$														
	2.24 or $\frac{323}{144}$ or $2\frac{35}{144}$	A1	CAO														
		3															

Q10

(i)	$P(RB) + P(BR) = \frac{4}{12} \times \frac{8}{11} + \frac{8}{12} \times \frac{4}{11}$ oe			M1	Multiply 2 probs together and summing two 2-factor probs, unsimplified, condone replacement								
	$P(\text{diff colours}) = \frac{64}{132} \left(\frac{16}{33} \right) (0.485)$ oe			A1	Correct answer								
	Method 2 $1 - P(BB) - P(RR) = 1 - \frac{4}{12} \times \frac{3}{11} - \frac{8}{12} \times \frac{7}{11}$			M1	Multiply 2 probs together and subtracting two 2-factor probs from 1, unsimplified, condone replacement								
	$P(\text{diff colours}) = \frac{64}{132} \left(\frac{16}{33} \right)$ oe			A1	Correct answer								
	Method 3 $P(\text{diff colours}) = \frac{{}^4C_1 \times {}^8C_1}{{}^{12}C_2}$			M1	Multiply 2 combs together and dividing by a combination								
	$= \frac{16}{33}$			A1	Correct answer								
				2									
(ii)	<table border="1"><tr><td>Number of red socks</td><td>0</td><td>1</td><td>2</td></tr><tr><td>Prob</td><td>$\frac{14}{33}$</td><td>$\frac{16}{33}$</td><td>$\frac{3}{33}$</td></tr></table>			Number of red socks	0	1	2	Prob	$\frac{14}{33}$	$\frac{16}{33}$	$\frac{3}{33}$	B1	Prob distribution table drawn, top row correct, condone additional values with $p = 0$ stated
	Number of red socks	0	1	2									
	Prob	$\frac{14}{33}$	$\frac{16}{33}$	$\frac{3}{33}$									
				B1	$P(0)$ or $P(2)$ correct to 3sf (need not be in table)								
				B1	All probs correct to 3sf, condone $P(0)$ and $P(2)$ swapped if correct								
			3										
(iii)	$E(X) = 1 \times \frac{16}{33} + 2 \times \frac{3}{33} = \frac{16}{33} + \frac{6}{33} = \frac{22}{33} \left(\frac{2}{3} \right)$			B1ft	ft their table if 0, 1, 2 only, $0 < p < 1$								
				1									

Q11

(i)	<i>EITHER:</i> $P(X=3) = P(RRB) = \frac{2}{6} \times \frac{1}{5} \times \frac{4}{4}$	(M1)	probabilities in order $\frac{2}{p} \times \frac{1}{q} \times \frac{4}{r}$, $p, q, r \leq 6$ and $p \geq q \geq r$, $r \geq 4$, accept $\times 1$ as $\frac{4}{r}$.
	$= \frac{1}{15}$ AG	A1)	Needs either P(RRB) OE stated or identified on tree diagram.
	<i>OR1:</i> $P(X=3) = P(RRB) = \frac{{}^2C_2}{{}^6C_2} \times \frac{{}^4C_1}{{}^4C_1}$	(M1)	probabilities stated clearly, $\times \frac{{}^4C_1}{{}^4C_1}$ or $\times 1$ or $\times \frac{4}{4}$ included
	$= \frac{1}{15}$ AG	A1)	Needs either P(RRB) OE stated or identified on tree diagram.
	<i>OR2:</i> $P(X=3) = P(RRB) = \frac{{}^2C_1}{{}^6C_1} \times \frac{{}^1C_1}{{}^5C_1} \times \frac{{}^4C_1}{{}^4C_1}$	(M1)	probabilities in order $\frac{{}^2C_1}{{}^6C_1} \times \frac{{}^1C_1}{{}^5C_1} \times \frac{{}^4C_1}{{}^4C_1}$ $p, q, r \leq 6$ and $p \geq q \geq r$, $r \geq 4$ ($\times \frac{{}^4C_1}{{}^4C_1}$ or $\times 1$ or $\times \frac{4}{4}$ acceptable)
	$= 1/15$ AG	A1)	Needs either P(RRB) OE stated or identified on tree diagram.
		2	

(ii)	$P(1) = P(B) = \frac{4}{6} \left(\frac{2}{3} = 0.667 \right)$ $P(2) = P(RB) = \frac{2}{6} \times \frac{4}{5} = \frac{4}{15} (= 0.267)$ $P(3) = P(RRB) = \frac{2}{6} \times \frac{1}{5} \times \frac{4}{4} = \frac{1}{15} (= 0.0667)$ <table border="1" data-bbox="264 1137 544 1238"> <tr> <td>x</td><td>1</td><td>2</td><td>3</td></tr> <tr> <td>P</td><td>$\frac{10}{15}$</td><td>$\frac{4}{15}$</td><td>$\frac{1}{15}$</td></tr> </table>	x	1	2	3	P	$\frac{10}{15}$	$\frac{4}{15}$	$\frac{1}{15}$	B1	Probability distribution table drawn with at least 2 correct x values and at least 1 probability. All probabilities $0 \leq p < 1$.
x	1	2	3								
P	$\frac{10}{15}$	$\frac{4}{15}$	$\frac{1}{15}$								
B1	P(1) or P(2) correct unsimplified, or better, and identified.										
B1	All probabilities in table, evaluated correctly OE. Additional x values must have a stated probability of 0										
		3									

Q12

(i)	$k(-2)^2$ is the same as $k(2)^2 = 4k$					B1	need to see $-2^2 k$, $2^2 k$ and $4k$, algebraically correct expressions OE										
	Total:					1											
(ii)	<table border="1"><tr><td>x</td><td>-2</td><td>-1</td><td>2</td><td>4</td></tr><tr><td>Prob</td><td>$4k$</td><td>k</td><td>$4k$</td><td>$16k$</td></tr></table>					x	-2	-1	2	4	Prob	$4k$	k	$4k$	$16k$	B1	-2, -1, 2, 4 only seen in a table, together with at least one attempted probability involving k
	x	-2	-1	2	4												
	Prob	$4k$	k	$4k$	$16k$												
	$4k + k + 4k + 16k = 1$					M1	Summing 4 probs equating to 1. Must all be positive (table not required)										
	$k = 1/25$ (0.04)					A1	CWO										
Total:					3												
(iii)	$E(X) = -8k + -k + 8k + 64k = 63k$					M1	using $\sum px$ unsimplified. FT their k substituted before this stage, no inappropriate dividing										
	$= 63/25$ (2.52)					A1											
	Total:					2											

Q13

(i)	$P(1 \text{ T-shirt}) = \frac{{}^3C_1 \times {}^9C_2}{{}^{12}C_3}$				AG	B1	[3]	Correct num unsimplified										
	$= 27/55$					B1		Correct denom unsimplified										
	OR $3/12 \times 9/11 \times 8/10 \times {}^3C_1$ oe				AG	B1		Answer given, so process needs to be convincing										
	$= 27/55$					M1		Mult 3 probs diff denoms (not a/3 x b/4 x c/5)										
						M1		Mult by 3C_1 oe										
						A1		Answer given, so process needs to be convincing										
(ii)						B1	[4]	0, 1, 2, 3 only seen in top line (condone additional values if Prob stated as 0)										
	<table><tr><td>X</td><td>0</td><td>1</td><td>2</td><td>3</td></tr><tr><td>Prob</td><td>84/220</td><td>27/55</td><td>27/220</td><td>1/220</td></tr></table>	X	0	1	2	3	Prob	84/220	27/55	27/220	1/220					B1		One correct prob, correctly placed in table
X	0	1	2	3														
Prob	84/220	27/55	27/220	1/220														
						B1		One other correct prob, correctly placed in table										
						B1✓		One other correct prob ft $\Sigma p = 1$, 4 values in table										

Q14

(i)	$6p + 0.1 = 1$ $p = 0.15$		B1	Correct answer
(ii)	$\text{Var}(X) = 1 \times p + 1 \times 2p + 4 \times 2p + 16 \times 0.1 - 1.15^2$ $0.15 + 0 + 0.3 + 1.2 + 1.6 - 1.15^2$ $= 1.9275 = 1.93 \text{ (3sf)}$		M1	Correct unsimplified formula, <i>their</i> p substituted (allow 1 error)
			A1	Correct answer
			2	

Q15

(i)	$\frac{1}{4} + p + p + \frac{3}{8} + 4p = 1$ $p = \frac{1}{16}$		M1	Unsimplified sum of probabilities equated to 1 If method FT from <i>their</i> incorrect (i), expressions for $E(X)$ and $\text{Var}(X)$ must be seen unsimplified with all probabilities < 1 , condone not adding to 1
			2	
(ii)	$[E(X)] = -\frac{1}{4} + \frac{1}{16} + \frac{6}{8} + 1 = \frac{25}{16}$ $[\text{Var}(X)] = \frac{1}{4} + \frac{1}{16} + \frac{12}{8} + \frac{16}{4} - \left(\text{their} \frac{25}{16}\right)^2$ $\frac{863}{256}$ or 3.37		M1	May be implied by use in Variance, accept unsimplified Substitute into correct variance formula, must have '– their mean ² ' OE
			3	
(iii)	$P(X = 2 X > 0) = \frac{P(X = 2)}{P(X > 0)} = \frac{\frac{3}{8}}{\frac{11}{16}}$		M1	Conditional probability formula used consistent with their probabilities
			A1	
	$\frac{6}{11}$ or 0.545		2	

Q16

$p + q = 0.45$	M1	Equation involving $\Sigma P(x) = 1$
$0.15 + 2p + 1.2 + 6q = 3.05$	M1	Equation using $E(X) = 3.05$
$q = 0.2$	M1	Solving simultaneous equations to one variable
$p = 0.25$	A1	Both answers correct
	4	